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Events Indicating the Start of Behavioral Momentum in Men's Division I-A Intercollegiate Basketball Games

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by

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Abstract

The purpose of this study was to determine which events indicate the start of behavioral momentum in men's Division I-A intercollegiate basketball games. The researcher videotaped 15 televised games, and recorded offensive and defensive events for both teams in sequence on a frequency chart. Each event was assigned a specific momentum point value. Defensive events began a period of momentum 50% of the time, and offensive events began a period of momentum 50% of the time. A chi-square analysis indicated that there was no significant difference between a defensive event and an offensive event in relation to the start of a period of behavioral momentum. Once a period of momentum was established, the team with momentum outscored the opponent 94.7% of the time during the given momentum period. However, there was no evidence to indicate the team that established more momentum periods during a game had a better chance of winning the contest. The use of a time-out called by the non-momentum team was determined to be an effective intervention to end the period of momentum. The instrument used in this study was found to be more objective and sensitive than previously used instruments, but future research is necessary to further develop and validate an instrument to reliabiy measure periods of momentum.

CHAPTER 1

INTRODUCTION

Sporting events contain periods of time in which one team significantly outperforms the other. This phenomenon is known as momentum. "The concept of momentum is one of the most commonly referred to and least understood phenomena in the realm of sports" (Taylor & Demick, 1994, p. 51). Researchers have yet to agree upon an operational definition of momentum. Two types of momentum have been discussed in the literature: psychological and behavioral.

Psychological momentum is an "added or gained psychological power that changes interpersonal perceptions and influences an individual's mental and physical performance" (Iso-Ahola & Mobily, 1980, p. 391). In a free throw shooting task, participants were judged using a scoring system with a bonus for ending on a made shot and a penalty for ending on a missed shot. It was observed that "shooters with positive momentum continue shooting...[and] shooters with negative momentum often pass up a shot they would normally take" (Mack & Stephens, 2000, p. 354). When participants experience psychological momentum, they believe their performances are affected by it (Cornelius, Silvia, Conroy, & Petersen, 1997).

Behavioral momentum, on the other hand, is thought to be "an unbroken series of positive or negative events occurring during a contest" (McCutcheon, 1997, p. 195). Behavioral momentum occurs when a team significantly outperforms its opponent with a string of positive events. Over the course of a variety of high school and college basketball games, the five most frequently occurring events to begin a

period of perceived momentum were in rank order, a 3-point shot, defensive stop, steal, fastbreak, and a turnover (Burke, Burke, & Joyner, 1999).

Participants have agreed that "momentum consists of increases in performance accompanied by emotional changes" (Burke, Edwards, Weigand, & Weinberg, 1997, p. 79). However, the authors agree upon the events that mark the beginning and end of momentum less than 25 percent of the time. Furthermore, momentum is often started by a combination of events rather than a single event Burke, et al., 1997). Usually behavioral momentum begins with a good performance by one team and a poor performance by the opponent (Burke, et al., 1999). Therefore, events in any competitive activity (e.g., basketball) indicate the start, duration, and end of a period of momentum.

However, there is much controversy surrounding the effect of momentum on performance. Vergin (2000) challenged the importance that athletes, fans, and the media place on the phenomenon. He argues that the concept of momentum is only a casual factor that does not have any bearing on the outcome of games. For example, in relation to individual performance and basketball, performance does not increase due to the making or missing of a basket on the previous shot (Gilovich, Vallone, & Tversky, 1985). Most makes and misses are based on random sequences. Fans often have an inaccurate perception of momentum because they only remember when a player makes several shots in a row. They do not seem to recall the times when players miss shots following a previously made basket.

Three major findings have been reported regarding behavioral momentum in basketball. First, as positive events in the three minutes preceding a turnover increase, the number of unfavorable events following the turnover decrease (Mace, Lalli, Shea, & Nevin, 1992). Second, when being outscored by their opponents by a wide margin of points, basketball coaches called a time-out. Third, the number of positive events was nearly equal for both teams after time-outs, suggesting that a time-out is an effective intervention in the face of adversity.

While there have been studies completed on behavioral momentum, researchers have yet to develop an effective and complete instrument to measure it. The instrument used in Burke, et al. (1999) was too subjective because all periods of momentum were subjected to the biases and opinion of a single observer who tracked momentum based upon her perceptions and expertise in the field. McCutcheon (1997) assigned momentum points to events in the game, but listed point values for only seven events. While this instrument appeared to be somewhat more objective due to the justifications given for momentum points, the incompleteness of the list of events hindered its sensitivity to measure behavioral momentum. In fact, neither team established momentum in 23% of all games. A more sensitive instrument may more accurately identify periods in which momentum is established.

Purpose of the Study.

Since momentum usually begins with a good performance by one team and a poor performance by the opponent (Burke, et al., 1999), there should be events in basketball that indicate the start, duration, and end of momentum. The purpose of the

study was to determine which events indicate the start of behavioral momentum in men's Division I-A intercollegiate basketball games.

Hypothesis.

The five most frequent events reported to begin a period of perceived momentum were a 3-point shot, defensive stop, steal, fastbreak, or a turnover (Burke, et al., 1999). Given that three of these events were defensive in nature, it is hypothesized that a positive defensive play will start a period of momentum.

Operational Definitions.

Start of momentum. Any period where a given team establishes seven consecutive momentum points (McCutcheon, 1997).

Period of momentum. A period in which the team that has established momentum keeps it by scoring 3.6 momentum points or more out of every given seven-point interval. Such a period continues until the end of momentum occurs.

End of momentum. The span of events where the non-momentum team scores a minimum of 3.6 momentum points in any given seven-point interval.

Positive defensive plays. The defensive events listed on the performance scale (see Appendix B). Listed in order of point rank, they include a steal, defensive stop, offensive foul, expired shot clock, blocked shot, and a defensive rebound.

Positive offensive plays. The offensive events listed on the performance scale (see Appendix B). Listed in order of point rank, they include a 3-point field goal, dunk, goaltending, 2-point field goal, offensive rebound, and a free throw made.

Assumptions.

1. The athletes are performing to the best of their abilities.
2. The level and quality of observed games is representative of NCAA Division I-A men's intercollegiate basketball games.
3. The instrument used to test momentum is an accurate scale to indicate events that include behavioral momentum.
4. Each event that occurs in a game is independent of any other event and will be given momentum points based upon its classification.

Delimitations.

1. Fifteen televised men's Division I-A intercollegiate games will be used in the study.
2. A game will not be included in the results of the study if the total point margin at the end of the game is 20 or more points (McCutcheon, 1997).

Limitations.

The instrument used in this study:

(a) has yet to be validated.

(b) assigned subjective point values to events.

(c) assigned subjective point values to events previously unaccounted for by other studies.

Significance of Study.

There are clear conflicts in the literature on behavioral momentum in sports. Much of the existing literature indicates that there needs to be more research completed in this area. However, the instruments currently used to indicate momentum patterns are still under investigation, and a more sensitive instrument would positively contribute to the existing literature regarding behavioral momentum in basketball. It is intuitively obvious that there are strings of events that seem to favor one team during particular periods of competitive activities. Therefore, there must be certain events more likely to start momentum.

If there are periods of momentum that positively affect performance, the application of this research will be of major significance to head coaches. Coaches who are aware of periods of momentum would be more likely to use that data as a part of game management strategy, and would be more knowledgeable regarding how behavioral momentum relates to events in a contest. This should help coaches determine on which plays to focus in particular game situations.

CHAPTER 2

REVIEW OF LITERATURE

The purpose of the study was to determine which events indicate the start of momentum in men's Division I-A intercollegiate basketball games.

Views of Momentum.

The existence of momentum in basketball is controversial. Some studies deny the existence of the phenomenon while others suggest it is real. Spectators and announcers often make reference to a team having momentum without having any clear basis for making such a statement.

Momentum is split into two categories in most studies: psychological momentum and behavioral momentum. While this study will focus primarily on behavioral momentum, an understanding and review of both types of momentum will provide a more thorough understanding of this complex topic.

There are many different definitions of momentum. This is evident from a study by Burke, et al., (1997) in which the authors attempted to (a) determine if momentum exists, (b) determine the importance of events that occurred just prior to the momentum, and (c) have the subjects define momentum.

The subjects were 20 NCAA Division I tennis players and 78 students who either played or coached basketball. The tennis subjects watched a 20-minute videotape of an U.S. Open tennis match and the basketball subjects viewed a quarter from a NBA game. Both studies indicated that there was a lack of agreement among the spectators as to which events started and ended momentum (Burke, et al., 1997).

Models of Momentum.

Due to the lack of consensus regarding which events are related to momentum, there is a need to understand the theoretical models of momentum. Taylor and Demick (1994) created the Multidimensional Model of Momentum in Sports that hypothesized that momentum is developed through a series of six stages. The authors described these stages as:

> "(a) precipitating event or events, (b) change in cognition, affect, and physiology, (c) change in behavior, (d) the resulting increase or decrease in performance consistent with the above changes, (e) a contiguous and opposing change in the previous factors on the part of the opponent (for sports with head-to-head competition), and (f) a resultant change in the immediate outcome" (Taylor & Demick, 1994, p. 51).

In focusing on the first stage, Taylor and Demick (1994) had 25 tennis players and 12 recreational basketball players fill out questionnaires indicating the top ten events that bring about changes in momentum in their respective sports. In addition, a trained observer watched videotapes of five US Open Tennis Matches and five games from the NCAA Tournament. Each match and game was assessed for momentum using a designed assessment form. The results indicated that more than one positive event favoring a team "may be necessary for a change in an immediate outcome to occur" in basketball (Taylor & Demick, 1994, p. 66). In regard to tennis, there was no conclusive evidence to indicate that a single favorable event or multiple favorable events led to an immediately positive outcome.

Mack and Stephens (2000) followed up the previous study by examining the first three stages of the model. They wanted to determine whether or not a precipitating momentum event would produce corresponding changes in cognition, affect, and physiology. One hundred twenty-five university students were recruited to participate in a foul-shooting task. The subjects could complete up to four levels of shots and were given the option to pass up a shot at any time.

A scoring system, with a bonus for ending on a made shot and a penalty for ending on a missed shot, was used to calculate the total points for each participant. It was observed that "shooters with positive momentum continue shooting...[and] shooters with negative momentum often pass up a shot they would normally take" (Mack & Stephens, 2000, p. 354).

This study had two significant findings. First, changes in momentum led to immediate changes in cognitive state in two of the three cognitive measures. On the other hand, there was no evidence to support the claim that momentum would lead to persistent changes in cognitive state. Therefore, while athletes might believe that they are hot or cold, it does not affect their ability to continue to try and make baskets (Mack & Stephens, 2000).

The psychological aspect of momentum as it relates to performance has also been examined and proposed as part of the Projected Performance Model. This study set out to determine "what factors contribute to the cognitive identification of psychological momentum and the relationship of these cognitions to changes in performance" (Cornelius, et al., 1997, p. 477). One hundred thirty-two undergraduate

volunteers were recruited from university physical education classes. The participants were paired up and instructed to make as many free throws as possible in a 90-second interval. They competed independently against each other in two separate matches. The subjects did not know how their opponent scored until the end of both rounds. Each participant was asked to fill out a predesigned form at the beginning, middle, and end of the competition (Cornelius, et al., 1997).

. The results showed that there was not a correlation between performance and perceived momentum. The finding "suggests positive and negative momentum are labels for performance that are misused if they are attributed magical powers for determining the outcomes of events" (Cornelius, et al., 1997, p. 483). Put another way, positive and negative psychological momentum simply constituted a labeling process in relation to performance.

Studies Denying the Major Impact of Momentum on Performance in Basketball.

In a study by Gilovich, et al., (1985) the authors challenged the validity of the relationship between momentum and performance. The authors obtained field goal records for 48 home games of the Philadelphia 76ers and successive free throw statistics for NBA players, and conducted a controlled shooting experiment with 14 members of the Cornell basketball team. The results indicated that "the outcomes of both field goal and free throw attempts were largely independent of the outcome of the previous attempt" (Gilovich, et al., 1985, p. 309). Since most makes and misses were based on random sequences, the authors concluded that a player was not more likely to make a successive basket if he made the previous shot.

The authors also indicated that fans often did not remember all periods of momentum because they only remembered when players made several shots in a row. Furthermore, spectators did not accurately recall the times when players missed shots following a previously made basket (Gilovich, et al., 1985).

In a study by McCutcheon (1997), the author set out to determine if the establishment of momentum would lead to athletic improvement. A table was developed for three sports: basketball, football, and wrestling. A scoring system was developed in which events were assigned different momentum point values depending upon their significance. For example, in basketball, a three-point field goal was worth 3 points whereas "points to Team A if Team B loses a starter" equaled 1.5. Seven consecutive momentum points had to be scored by a team before a period of momentum was established (McCutcheon, 1997).

The findings suggest that there was no significant difference in the number of momentum points during the first five events immediately following the establishment of momentum by the favorable teams. Once momentum started, however, it dissipated rapidly. Therefore, the author concluded that winning teams often win because they are better than their opponents, not because of momentum streaks (McCutcheon, 1997).

A study by Vergin (2000) suggests that the concept of momentum is only a casual, or miniscule, factor in determining the outcome of contests over the span of several games. The author set out to challenge the belief of athletes, sports fans, and the media that momentum is an important phenomenon in athletic contests. Using

two statistical models, the Wald-Wolfowitz test for randomness and the chi-square for goodness-of-fit test, Vergin examined actual winning and losing streaks for the 29 NBA teams over the course of 2 seasons from 1996-1998. The results indicated that momentum had only a casual effect on the outcome of basketball games. There were no findings to support a relationship between winning and losing a contest and the result of the previous game. Thus the authors concluded that athletes, sports fans, and the media place an unjustified weight upon momentum as it relates to streaks in sporting events (Vergin, 2000).

Studies Supporting a Relationship between Momentum and Performance in Basketball.

On the other side of the issue are those who claim that there is evidence to support a positive correlation between momentum streaks and performance in basketball. Shaw, Dzewaltowski, & McElroy (1992) hypothesized that repeated success would lead to increases in perceived psychological momentum, subsequent performance, and self-efficacy. The subjects were 60 male undergraduate physical education students who agreed to participate in a basketball free throw shooting contest. Participants were placed randomly in a repeated failure group or in a repeated success group. In each group, they competed against a highly skilled shooter. The results indicated that experiencing competitive success increased perceptions of momentum, whereas experiencing competitive failure decreased perceptions of it. Therefore, the authors concluded that competitive success was most

likely to occur when the confidence level of the subject was increased (Shaw, et al., 1992).

Mace, et al., (1992) examined how college basketball teams received reinforcers and responded to adversities. The authors videotaped 14 college basketball games during the 1989 NCAA tournament. Events were classified into one of three categories: reinforcers, adversities, and responses to adversities. The target team obtained reinforcers (3-point field goals, 2-point field goals, 1-point foul shots, and turnovers favoring the target team) and adversities (turnovers favoring the opposing team, missed field goals, missed foul shots, and commissions of shooting fouls against the opposing team). Responses to adversities were the results of the first possession of the ball by the target team immediately following an adversity.

This study revealed three major findings. First, sixty-seven percent of the time, favorable responses to adversity increased as the rate of reinforcement increased in the three minutes preceding the given adversity. Second, when being outscored by their opponents on an average of 2.63 to 1.0, basketball coaches called a time-out. Third, the rates of reinforcements after time-outs were nearly equal for both teams. These results led the authors to conclude that calling a time-out appeared to be an effective intervention for adversity (Mace, et al., 1992).

In a case study investigation, Burke, et al., (1999) set out to determine if momentum could be perceived consistently by one trained observer during several high school and college basketball games. The observer attended three high school and eleven college basketball games and recorded 50 instances of perceived

momentum. The trained observer used the same chart for each perceived period of momentum.

Based upon the judgment of the observer, momentum usually started with a good performance by one team and a poor performance by the opponent. The events, in ranked order, that were most likely to begin a stretch of momentum were a 3-point shot, defensive stop, steal, fastbreak, and a turnover. Throughout a stretch of momentum, turnovers, crowd noise, defensive stops, steals, and a "string" of unanswered points were likely to maintain momentum. The events most likely to end momentum were turnovers on the part of the momentum team, missed shots by the momentum team, time outs, fouls, and end of the playing period (Burke, et al., 1999).

Most of the previous studies on behavioral momentum indicated that more research should be completed on this topic. In Burke, et al., (1999), a trained observer tracked momentum to determine when momentum began, what actions took place during the momentum, and what events ended momentum. Many games were observed live while some were watched on videotape.

The instrument used by Burke, et al., (1999) was the most comprehensive in the literature with regards to the listing of events. Events such as dunk, great pass, string of points, and crowd noise were listed. The objectivity of the study, however, is in question since the author gave no operational definitions. Therefore, it must be assumed that the trained observer was making conclusions based upon opinion.

McCutcheon (1997) used a somewhat more objective method to track the outcomes of games and perceived momentum within those games. A table and time

line were used to record events to which momentum points had been assigned. The momentum points were similar to the actual scoring system of the game. However, there were only seven listed events that had been assigned point values. These included a three-point field goal, two-point field goal, free throw, slam dunk, offensive rebound, steal or forced turnover in backcourt, and points to Team A if Team B loses a starter (McCutcheon, 1997).

. A panel of experts determined the amount of momentum points assigned to each event. The panel consisted of 60% coaches, 30% athletes, and 10% experienced fans (McCutcheon, 1997). There was no process outlined for how an experienced fan was chosen. The objectivity of this instrument appears to be greater than that of the one used in Burke, et al., (1999), due to the justification of momentum points. However, the list of events is much smaller than the chart developed in Burke, et al., (1999). When the number of events recorded is decreased, it appears to make the instrument less sensitive.

An instrument that combines elements of the instruments listed above may be more sensitive and produce more objective results. The concept of assigning momentum points to events allows for greater objectivity than relying upon the "expertise" of one observer to indicate when a period of momentum has occurred. There is, however, a need to include more events to make the instrument as sensitive as possible so it will measure periods of momentum more accurately.

CHAPTER 3

METHODS AND PROCEDURES

Participants.

One trained observer (TO) collected data. The TO was a 26-year-old male who had experience playing and coaching basketball at the high school level. He played high school basketball for two years at both the junior varsity and varsity levels, and served as head coach of a junior varsity team that won league titles in both seasons he coached. The TO observed videotapes of the first 15 men's N.C.A.A. Division I-A basketball games televised during the 2002-2003 NCAA basketball season on ABC and/or CBS Sports. Scoring methods were criterion based during each observation.

Instrument.

The instrument used in this study was not comprehensive of all events that occur in a men's Division I-A intercollegiate basketball game. However, it was the most comprehensive to date. The researcher combined elements of the instruments used by Burke, et al., (1999) and McCutcheon (1997) to create a more objective and comprehensive measuring device. The chart contained the same momentum point values used by McCutcheon (1997). For the sake of clarity, the researcher defined defensive stops as instances of offensive goaltending, jump balls (given that one team clearly had possession before the jump ball), and all other turnovers that were not accounted for under defensive events on the momentum chart.

To increase the sensitivity of the instrument, five events (goaltending, offensive foul, expired shot clock, blocked shot, and defensive rebound) were added to the chart. Defensive goaltending gave the opposing team 0.7 momentum points plus the momentum points awarded for the made field goal. The rationale for 0.7 points is to award the offensive team some points without over emphasizing the event. This point value is one half the point value assigned for blocking a shot.

An offensive foul and expired shot clock were 2.0 momentum points each for the team that was on defense. These events are an extension of a steal or forced turnover in backcourt (McCutcheon, 1997), and, although the events will most likely not occur in the opponents' backcourt, they are equally significant defensive stops.

A blocked shot was awarded 1.4 momentum points. It was noted that some blocked shots will go directly out of bounds, some will be recovered by the defensive team, and some will be recovered by the offensive team. In this study, if the blocked shot immediately made contact with the rim or backboard, the team that recovered the ball was credited with the rebound. If a shot was blocked and did not contact the rim or backboard, it was treated as a loose ball, and the team that recovered received no additional momentum points. Therefore, 1.4 points were assigned to a blocked shot so that it would be treated similarly to a rebound.

McCutcheon (1997) assigned 1.4 points for an offensive rebound, so the researcher will also award 1.4 momentum points for a defensive rebound for consistency. In addition, if a shot was attempted and the rebound went out of bounds

before a team was able to secure the ball, no momentum points were attributed to either team.

The researcher eliminated *Points to Team A if Team B loses a starter* from McCutheon's (1997) table. Such an event is random and its effect, if any, should be observable in the continued performance of the two teams. In addition, a loss of a starter is not necessarily offensive or defensive in nature.

Procedure.

The observer watched each videotape in its entirety, tracked events for both teams, and recorded every event in sequence on a frequency chart (see Appendix A). Events were tallied in a coded manner (see Appendix B). Each team was color-coded before the game began to allow the observer to tally events for both teams more accurately. Team time outs, television timeouts, and the ends of halves were also noted.

At the conclusion of the game, the observer used the momentum point chart (Appendix B) to assign point totals to the events listed on the frequency chart (Appendix A). The observer tracked 1.5 games, or ten percent of the overall study a second time after all games were recorded to show intrarater reliability. Any game that had a margin of 20 or more points was rejected to reduce the possibility of discrepancies in ability affecting the results of the study (McCutcheon, 1997).

Research Design and Analysis.

Events were recorded and points were transferred from the momentum point chart to the frequency chart. The observer then indicated each period of momentum. The chi-square method was used to compare the number of defensive events to offensive events that started a period of momentum. A paired/dependent t-test was used to compare the average number of offensive events to the average number of defensive events in all fifteen games.

The event that began each period of momentum was categorized for each game and each team. At the conclusion of 15 games, the observer evaluated which events most frequently began a period of momentum, and tested the results against the hypothesis.

CHAPTER 4

RESULTS

The purpose of the study was to determine which events indicate the start of momentum in men's Division I-A intercollegiate basketball games. All games used in the study can be found in Appendix C.

Across the fifteen observed games, there was an average of 8.8 periods of momentum per game. There were 132 total momentum periods. Sixty-six were begun by a defensive event and sixty-six were begun by an offensive event. A complete listing of events that began a period of momentum is listed in Table 1.

Table 1 Events that Began a Period of Momentum

Offensive Events	Number	Percentage	Defensive Events	Number	Percentage
2-point field goal	23	17.4%	Defensive rebound	32	24.2%
3-point field goal	15	11.4%	Steal	15	11.4%
Offensive rebound	13	9.8%	Blocked shot	11	8.3%
Free throw made	12	9.1%	Offensive foul	5	3.8%
Dunk	3	2.3%	Defensive stop	3	2.3%

A chi-square analysis was conducted to look at the relationship between defensive events and offensive events beginning a period of momentum. The observed outcomes matched the expected outcome of half the total events observed. Since the difference of the events was zero, the chi-square analysis was also zero, indicating that there was no difference between what was observed and what was expected (see Table 2).

Table 2 Chi-Square Analysis

	Offensive events	Defensive events	Total
Observed (O)	66	66	132
Expected (E)	66	66	132
O-E	0	0	0

An intrarater reliability check was completed on Game 8 and the first half of Game 9. The researcher chose the middle games of the study to alleviate the possibility of skewed data from the extremes of the beginning or end games. The results show that the observer was accurate 591 out of 617 times (95.8% of the time), suggesting high reliability.

A second analysis was conducted on the data using a paired/dependent t-test. The average number of offensive events were compared to the average number of defensive events in each of the 15 observed games. The total number of offensive events for all 15 games was 1523, with a mean of 101.53 per game and a standard deviation of 12.18. The total number of defensive events was 1175, with a mean of

78.33 per game and a standard deviation of 8.92. The correlation between the total number of offensive events and total number of defensive events was 0.24.

A dependent t-test indicated that there was a significant difference between the average number of offensive and defensive events per game from the 15 games observed ($t = 6.78, p = 0.001$).

CHAPTER 5

DISCUSSION

The purpose of the study was to determine which events indicated the start of momentum in men's Division I-A intercollegiate basketball games. Given that three of the five most frequent events reported to begin a period of perceived momentum in Burke, et al., (1999), were a defensive stop, steal, and a turnover, the hypothesis was that a defensive event, as opposed to an offensive event, was more likely to begin a period of momentum. This hypothesis was evaluated using a chi-square analysis.

The findings of the chi-square analysis indicated that there were an equal number of defensive and offensive events that began periods of momentum. However, unlike many of the previous studies in which there was little agreement as to when behavioral momentum occurred, this investigation found clear instances of momentum throughout the course of basketball games.

The results of this study point to several conclusions that are relevant to behavioral momentum in basketball. First, the effect of a momentum period on performance during that momentum period was substantial. The team that had momentum outscored its opponent during a period of momentum 94.7% of the time (125 out of 132); there was no difference in score 4.5% of the time (6 out of 132); and the team that did not have momentum outscored the team with momentum 0.8% of the time (1 out of 132). The point differential is the margin of points the momentum team outscored their opponent by in each of the momentum periods. Calculations were determined by taking the sum of all point margins over all momentum periods in

each half. The average point differential between the momentum team and the non-momentum team was +4.1 points (see Appendix C).

On the other hand, there was no evidence to support the claim that the team establishing momentum more often in a game would have a better chance of winning that game. Across the 15 games, there were three instances in which the teams established an equal number of momentum periods; there were six instances in which the team that established more momentums won the game; and six instances in which the team with more momentums lost.

An effective and complete instrument has yet to be established for studies involving behavioral momentum. One previous instrument was too subjective (Burke, et al., 1999). Another utilized a table in which momentum points were assigned to game events, but assigned momentum point values to only seven events thus limiting the sensitivity of the instrument (McCutcheon, 1997).

The instrument used in this study increased the number of events by 71.4%. The statistics that show the relationship between periods of momentum and performance in this study should help to validate the instrument to some extent. In the McCutcheon (1997) study, neither team established momentum in 23% of all games. The new instrument developed from elements of those used by Burke, et al., (1999) and McCutcheon (1997) created a more objective and comprehensive measuring device. This was demonstrated by the fact that all fifteen games had established periods of momentum in which one team's performance was better during

the period of momentum. The number of momentum periods ranged from 5 to 12 with an average of 8.8 periods per game played.

The instrument used in this study was more sensitive than those used in previous studies. In McCutcheon's (1997) study, a panel of "experts" comprised of 60% coaches, 30% athletes, and 10% experienced fans determined the point values for seven events that occur in basketball games. That study did not indicate what criteria the panel used to assign momentum point values to events. The events that are tracked and the momentum point values that are assigned to each event must be validated before the results can be evaluated. The events chosen and the subsequent momentum point values given to each event were limitations in McCutcheon's (1997) study and are in this study as well.

A second conclusion from this study is that time-outs called by opposing teams appeared to be an effective means of ending periods of momentum. This result supports the previous finding that calling a time-out is an effective intervention in the face of adversity (Mace, et al., 1992). In this study, the non-momentum team called 43 time-outs when their opponent had established a period of momentum. The findings demonstrated that 58.1% of the time (25 out of 43) the team that had the momentum was outscored by their opponent during the remainder of the established momentum period after a called time-out. There was no scoring advantage for either team 27.9% of the time (12 out of 43). The team that had the momentum outscored their opponent 14.0% of the time (6 out of 43) during the remainder of the momentum period.

Surprisingly, television time-outs were not as effective an intervention as team time-outs in the face of adversity. In this study, there were 40 television time-outs during an established period of momentum. Findings showed that 27.5% of the time (11 out of 40) the team that had the momentum was outscored by its opponent during the remainder of the established momentum period. There was no scoring advantage for either team 20% of the time (8 out of 40), and the team that had the momentum outscored their opponent 52.5% of the time (21 out of 40) during the remainder of the momentum period after a television time-out.

The contrast between a time-out called by the non-momentum team and the use of a television time-out during a period of momentum is notable. It would seem that such a difference should not exist, because theoretically any stoppage of play where the coach would be able to address the team should have the same results. More research should be conducted to learn more about this phenomenon.

A third conclusion from this study is that the results differed from those of previous studies regarding what events were most likely to start, continue, and end periods of momentum. In Burke, et al., (1999), the events that were most likely to begin a period of momentum were, in rank order, a 3-point shot, defensive stop, steal, fastbreak, and a turnover. In the current study (see Table 1), the events that were most likely to begin a period of momentum were a defensive rebound (32 out of 132 or 24.2%), a 2-point shot (23 out of 132 or 17.4%), a steal and a 3-point field goal (15 out of 132 or 11.4% apiece), and an offensive rebound (13 out of 132 or 9.8%).

Events that were most likely to continue a period of momentum in Burke, et al., (1999) were, in rank order, turnovers, crowd noise, defensive stops, steals, and a "string" of unanswered points. In this study there were some strikingly different results (see Table 3).

Table 3 Events that Continued a Period of Momentum

Offensive Events	Number	Percentage	Defensive Events	Number	Percentage
2-point field goal	175	20.2%	Defensive rebound	168	19.4%
3-point field goal	66	7.6%	Steal	59	6.8%
Offensive rebound	93	10.8%	Blocked shot	53	6.1%
Free throw made	140	16.2%	Offensive foul	17	2.0%
Dunk	24	2.8%	Defensive stop	65	7.5%
Goaltending	1	0.1%	Expired Scot Clock	4	0.5%

Events that were most likely to end a period of momentum in Burke, et al., (1999) were, in rank order, turnovers on the part of the momentum team, missed shots

by the momentum team, time outs, fouls, and end of the playing period. The events by the opposing team that were most likely to end a period of momentum in the current study are shown in Table 4.

Table 4 Events that Ended a Period of Momentum

Offensive Events	Number	Percentage	Defensive Events	Number	Percentage
2-point field goal	27	21.3%	Defensive rebound	21	16.5%
3-point field goal	16	12.6%	Steal	7	5.5%
Offensive rebound	16	12.6%	Blocked shot	5	3.9%
Free throw made	15	11.8%	Offensive foul	6	4.7%
Dunk	3	2.4%	Defensive stop	10	7.9%
Goaltending	1	0.8%			

There is some discrepancy between the results of these two studies. One reason for this is that different events were considered in each study. Another reason could be the instrument used in each study. In Burke, et al., (1999), the observer used a subjective method to collect data; whereas, the current study was completed using a

more objective scoring system. More research needs to be done to validate a reliable instrument to track behavioral momentum. As researchers continue to develop instruments that are more stringent to determine the start, duration, and end of momentum periods, analyses of such events will become more valuable.

Conclusions.

The present study demonstrated that there are significant differences between the average number of offensive and defensive events in a game. Since the number of offensive and defensive events that started a period of momentum were the same (66 each), and there were a greater number of offensive events when compared to defensive ones (1523 versus 1175, respectively), one could argue (based on the percentage of defensive events from the total, to begin a period of momentum) that there is a higher likelihood that a defensive event will begin a period of momentum. However, it should be noted that this translates into a percentage of 5.62 and 4.33 for defensive and offensive events, respectively, resulting in a difference of 1.28% between the two. On the other hand, it could also be argued that because the average number of offensive events per game were significantly greater than the average number of defensive events per game, there is a greater probability that an offensive event will begin a period of momentum. But since no significant differences were found between the number of offensive and defensive events starting a period of momentum with a Chi-square analysis, this would suggest that neither an offensive or defensive event is more likely to start a period of momentum.

Once a period of momentum is established, the team with momentum almost always outscores the opponent during the given momentum period. However, there is no evidence to support the claim that the team that establishes more momentum periods during a game has a better chance of winning that game. On the other hand, the more momentum periods a team can accrue, the greater the chances that the given team will outscore its opponent and the more chances a team has to outscore its opponent, the greater the likelihood of victory.

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APPENDIX A

Date_____ Visiting Team_____ Home Team_____
Level_____ Color_____ Color_____

Key

Points

Key

Points

Key

Points

Key

Points

Key

Points

Key

Points

Key

Points

APPENDIX B

MOMENTUM CHART

Offensive Events	Key	Points
3-point field goal	3fg	3.0
Dunk	d	2.8
Goaltending (by opposing team)	g + ___	0.7 + ___
2-point field goal	2fg	1.9
Offensive rebound	or	1.4
Free throw made	1ft	1.2
Defensive Events	**Key**	**Points**
Steal	s	2.0
Defensive stop	ds	2.0
Offensive foul	of	2.0
Expired shot clock	esc	2.0
Blocked shot	bs	1.4
Defensive rebound	dr	1.4
Others	**Key**	**Points**
Time-out	to	
Television time-out	tv	
End of half	h	

APPENDIX C

RESULTS OF GAMES USED IN THE STUDY

Date	Network	Team	Final Score	Offensive Momentum	Defensive Momentum	Point Differential
11/30/02	CBS	Duke	84	2	1	+12
		UCLA	73	1	2	+10
12/7/02	CBS	Michigan	59	Game rejected due to final margin of victory being 20 or more points.		
		Duke	81			
12/14/02	CBS	Florida	69	1	3	+19
		Maryland	64	2	2	+19
12/14/02	CBS	Michigan St.	71	1	3	+18
		Kentucky	67	3	2	+16
12/21/02	CBS	Indiana	64	1	4	+25
		Kentucky	70	3	1	+25
12/28/02	CBS	Georgetown	75	3	3	+25
		Virginia	79	3	2	+26
12/28/02	ABC	Kansas	80	Game rejected due to programming error with VCR.		
		California	67			
1/5/03	CBS	Villanova	68	Game rejected due to game being joined in progress with 9:07 left in the 1st half.		
		Memphis	72			

Date	Network	Team	Final Score	Offensive Momentum	Defensive Momentum	Point Differential
1/18/03	CBS	Notre Dame	73	3	2	+13
		Kentucky	88	4	1	+24
1/18/03	CBS	Illinois	66	0	2	+10
		Indiana	74	4	2	+31
1/18/03	ABC	Duke	72	0	3	+12
		Maryland	87	3	3	+36
1/25/03	CBS	Arizona	91	2	3	+26
		Kansas	74	2	2	+18
1/26/03	CBS	Syracuse	54	1	2	+8
		Miami	49	3	1	+10
2/2/03	CBS	Illinois	65	Game rejected due to newsbreaks regarding the Columbia explosion.		
		Michigan St.	68			
2/8/03	CBS	UCLA	71	2	3	+19
		Georgetown	70	3	3	+19
2/9/03	CBS	Maryland	84	4	1	+16
		Georgia Tech	90	3	4	+26
2/9/03	ABC	Texas Tech	73	1	1	+7
		Missouri	82	1	2	+13

Date	Network	Team	Final Score	Offensive Momentum	Defensive Momentum	Point Differential
2/9/03	ABC	Pittsburgh	64	2	3	+17
		Notre Dame	66	2	1	+18
2/15/03	CBS	USC	59	Game rejected due to final margin of victory being 20 or more points.		
		Arizona	86			
2/15/03	ABC	Louisville	73	4	2	+14
		Marquette	70	2	2	+9

APPENDIX D

Date 11-30-02 Visiting Team___**Duke**____ Home Team____UCLA____
Level__1st Half__ Color_____**Bold**_____ Color_____Plain_____

Key	3fg	s	or	**dr**	**or**	dr	2fg	**2fg**	2fg	dr	**dr**
Points	3.0	2.0	1.4	**1.4**	**1.4**	1.4	1.9	**1.9**	1.9	1.4	**1.4**
Key	s	3fg	dr	2fg		**d**		**2fg**	**dr**	**3fg**	**ds**
Points	2.0	3.0	1.4	1.9	**To**	**2.8**	**Tv**	**1.9**	**1.4**	**3.0**	**2.0**
Key	s	**of**	**3fg**	**ds**	**or**	bs	**3fg**	or	2fg	1ft	of
Points	2.0	**2.0**	**3.0**	**2.0**	**1.4**	1.4	**3.0**	1.4	1.9	1.2	2.0
Key	**Tv**	**dr**	**2fg**	dr	**dr**	**2fg**	**bs**	dr	or	2fg	bs
Points		**1.4**	**1.9**	1.4	**1.4**	**1.9**	**1.4**	1.4	1.4	1.9	1.4
Key	ds	**of**	ds	**bs**	**bs**	**3fg**	2fg		**3fg**	or	**dr**
Points	2.0	**2.0**	2.0	**1.4**	**1.4**	**3.0**	1.9	**To**	**3.0**	1.4	**1.4**
Key	**or**	**d**		or	2fg	ds		**s**	**or**	**2fg**	**s**
Points	**1.4**	**2.8**	To	1.4	1.9	2.0	Tv	**2.0**	**1.4**	**1.9**	**2.0**
Key	dr	1ft	1ft	**3fg**	1ft	1ft	**or**	dr	1ft	1ft	
Points	1.4	1.2	1.2	**3.0**	1.2	1.2	**1.4**	1.4	1.2	1.2	Tv

Key	s	**ds**	**2fg**	**1ft**	**bs**	or	2fg	**3fg**	2fg	dr	**s**
Points	2.0	**2.0**	**1.9**	**1.2**	**1.4**	1.4	1.9	**3.0**	1.9	1.4	**2.0**

Key	**1ft**	**1ft**	2fg	ds	**ds**	**or**
Points	**1.2**	**1.2**	1.9	2.0	**2.0**	**1.4**

H

Score: **Duke 40**
UCLA 33

Date 11-30-02 Visiting Team____**Duke**____ Home Team___UCLA__
Level__2nd Half__ Color_____**Bold**_____ Color_____Plain_____

Key	**2fg**	**1ft**	2fg	dr	3fg	**or**	dr	**of**	**2fg**	2fg	**dr**
Points	**1.9**	**1.2**	1.9	1.4	3.0	**1.4**	1.4	**2.0**	**1.9**	1.9	**1.4**
Key	**3fg**	or	2fg	**2fg**	ds	**2fg**	**1ft**	**dr**	dr	Tv	or
Points	**3.0**	1.4	1.9	**1.9**	2.0	**1.9**	**1.2**	**1.4**	1.4		1.4
Key	**dr**	**2fg**	**dr**	**2fg**	To	or	**dr**	**2fg**	**1ft**	or	To
Points	**1.4**	**1.9**	**1.4**	**1.9**		1.4	**1.4**	**1.9**	**1.2**	1.4	
Key	1ft	**To**	**2fg**	1ft	**3fg**	2fg	**d**	2fg	**or**	dr	2fg
Points	1.2		**1.9**	1.2	**3.0**	1.9	**2.8**	1.9	**1.4**	1.4	1.9
Key	1ft	1ft	Tv	**2fg**	**s**	dr	**s**	dr	1ft	**dr**	**1ft**
Points	1.2	1.2		**1.9**	**2.0**	1.4	**2.0**	1.4	1.2	**1.4**	**1.2**
Key	dr	or	**dr**	dr	**dr**	dr	2fg	**2fg**	**1ft**	**Tv**	**s**
Points	1.4	1.4	**1.4**	1.4	**1.4**	1.4	1.9	**1.9**	**1.2**		**2.0**
Key	**2fg**	3fg	dr	or	2fg	s	1ft	**dr**	ds	Tv	3fg
Points	**1.9**	3.0	1.4	1.4	1.9	2.0	1.2	**1.4**	2.0		3.0
Key	ds	**ds**	**1ft**	**1ft**	1ft	1ft	**d**	**ds**	**To**	s	**s**
Points	2.0	**2.0**	**1.2**	**1.2**	1.2	1.2	**2.8**	**2.0**		2.0	**2.0**

Key	**2fg**	3fg	**2fg**	dr	1ft	1ft	**1ft**	dr	2fg	H
Points	**1.9**	3.0	**1.9**	1.4	1.2	1.2	**1.2**	1.4	1.9	

Score: **Duke 84**
UCLA 73